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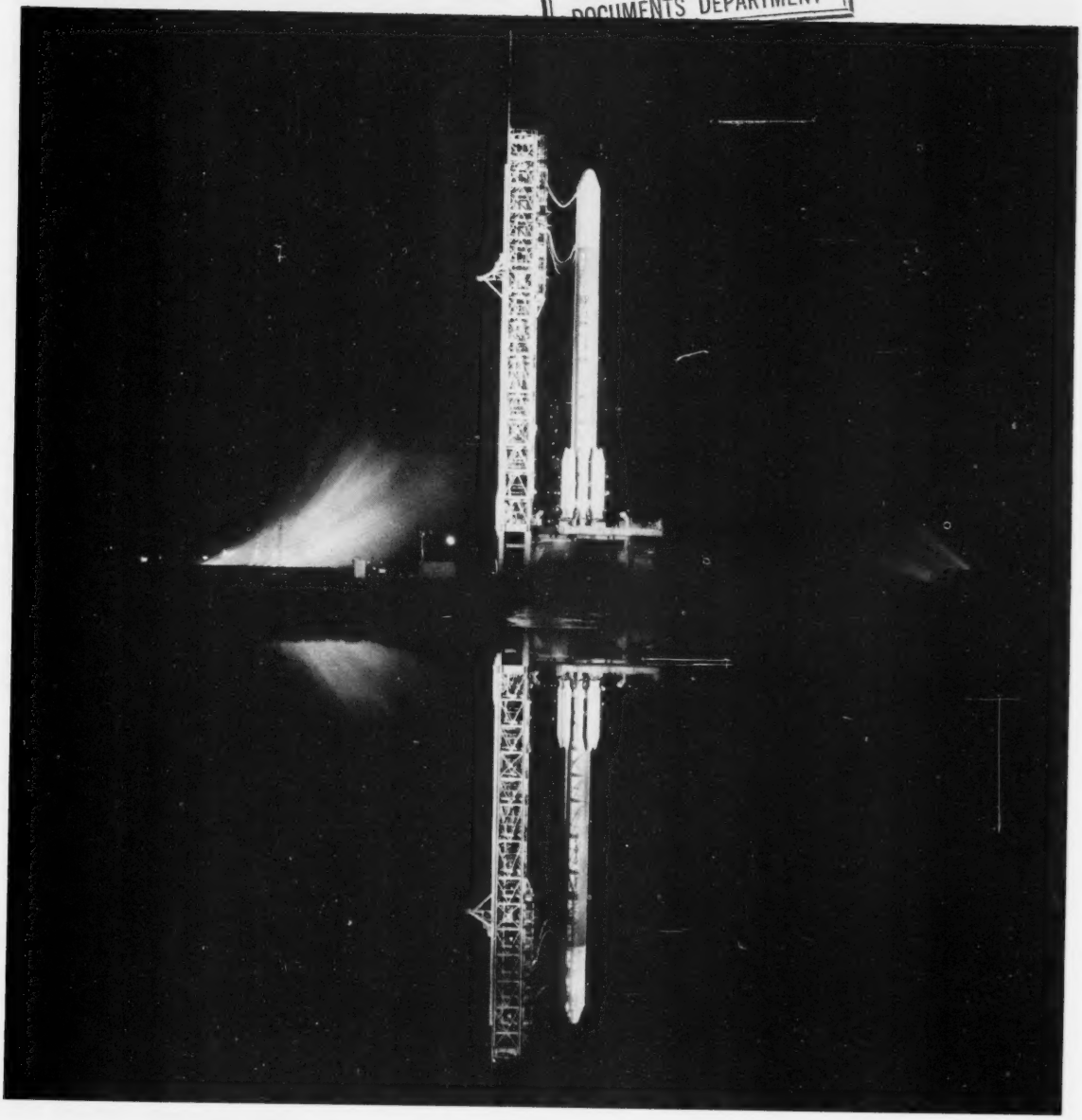

Cover

Mirror Image—Delta 143 is perfectly reflected in waters adjacent to launch complex 17 at Cape Canaveral shortly before GEOS–2 was launched, under the direction of the Kennedy Space Center, on July 14. NASA placed the European Space Agency's scientific satellite in stationary orbit 35,881 kilometers above the equator in Africa to study the Earth's magnetosphere.

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President Marks Space Anniversary

In a statement dated July 20, 1978, President Jimmy Carter said:

"Nine years ago today, the world paused to watch two brave men tread the surface of the Moon. It was a moment without precedent in human experience, a moment when terrestrial life reached out to touch another world. It is a source of pride for us that those men were Americans. Today, the lunar surface is criss-crossed in a half-dozen places with the footprints of American astronauts and implanted with a variety of American scientific instruments.

"The Space Shuttle, our next major manned space project, will begin regular, routine, economical operation in the early 1980's. Through it, we will use the vantage point of space to learn more about the Earth's surface features and processes and to improve our ability to manage our resources and cope with natural phenomena. We will continue to develop technology to realize the full potential of space communications and other practical applications of space technology.

"In the deeper reaches of space, we will continue to seek to expand our knowledge of the solar system and the universe of which we are a part.

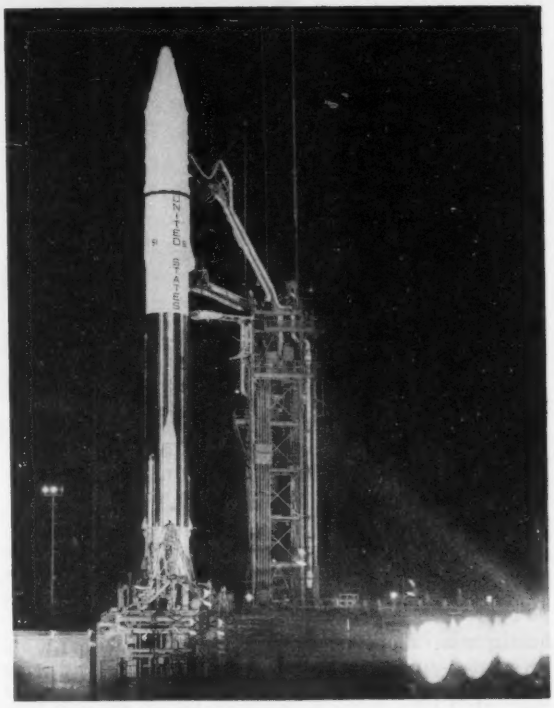
"As time and technology take us ever more deeply into the space age, it will continue to be our policy to conduct operations in space as required for our national well-being and to support the right of all nations to do likewise. In so doing, we remain committed to the underlying principle of the exploration and use of space for peaceful purposes and for the benefit of all mankind."

Up and Away Goes Second Pioneer Venus

NASA launched the second of two Pioneer spacecraft to Venus as part of a detailed scientific study of that cloud-shrouded planet. Riding atop an Atlas Centaur rocket, Pioneer Venus 2 lifted off from Cape Canaveral, Fla., on Aug. 8 for the start of a 354-million-kilometer journey to Earth's nearest neighbor.

Pioneer Venus 2 is a multiprobe spacecraft designed to make direct measurements of the dense, searing atmosphere of Venus from top to bottom. The atmosphere at the surface is 100 times as dense as Earth's and hotter than the melting points of lead and zinc, 485 degrees Celsius.

Thirteen million km and 20 days out from Venus, Pioneer Venus 2 will separate into five atmospheric entry craft. Four of these probes will enter the Venusian atmosphere at points spread over the planet's Earth-facing hemisphere, two on the day side and two on the night side. The fifth entry probe, the transporter bus, also will enter on the day side. The entry probes of Pioneer Venus 2 are planned to arrive five days after the Orbiter.



Pioneer Venus 2 just before launch.

The 30 experiments aboard Pioneer Venus 1 and 2 are planned as a coordinated observational system. The mission employs the largest number of spacecraft —six—ever devoted to one planet and will make the most measurements at the greatest number of locations. The flights are the first designed primarily to study of the atmosphere and weather of another planet on a global scale. Information gathered at Venus may help us learn more about the forces that drive the weather on our own planet.

Scientists believe Venus may be an unusually good place to study the mechanics of atmospheres because the planet rotates very slowly and there are no oceans. The atmosphere appears to be a relatively simple weather machine, and the important

atmospheric circulation motions appear to be global. Hence, continuous measurements from orbit, combined with those of the probes from many points in the atmosphere, could provide at least a rough picture of Venusian weather processes.

The five probe spacecraft that make up Pioneer Venus 2 will make direct measurements and observations from within the planet's atmosphere, providing by far the most detailed information yet on atmospheric composition, circulation and energy balance.

The multiprobe spacecraft employs a spin-stabilized, 2.4-meter diameter, cylindrical bus containing most spacecraft support systems. The four probes are launched from the bus toward Venus. The multiprobe weighs 904 kilograms and carries 51 kg of scientific instruments. Within the bus cylinder, a thermally-controlled equipment compartment houses instruments, communications and data-handling systems, as well as navigation, orientation, thruster and power systems. The exterior of the bus cylinder is covered with power-generating solar cells.

On its four-month journey to Venus, the spacecraft will fly about two-fifths of the way around the Sun between the orbits of Earth and Venus, some 354 million km.

Pioneer Venus 2 is made up of a transporter bus, a large probe craft (the sounder probe) and three identical smaller probe spacecraft (the north, day and night Probes).

These spacecraft, including the bus, will enter at points spread over Venus' entire Earth-facing hemisphere, about 10,000 km (6,000 mi.) apart. The bus will obtain data on the composition of the uppermost part of the atmosphere before burning up. The other four probes will make detailed measurements of the atmosphere at lower altitudes as they descend to the surface. The probes are not designed to survive after impact, but they may return surface data briefly.

Because of its high density, temperatures, and corrosive constituents, the Venusian atmosphere presents a difficult problem for designers of entry craft. The high entry speeds of about 41,600 km per hour add to the problem.

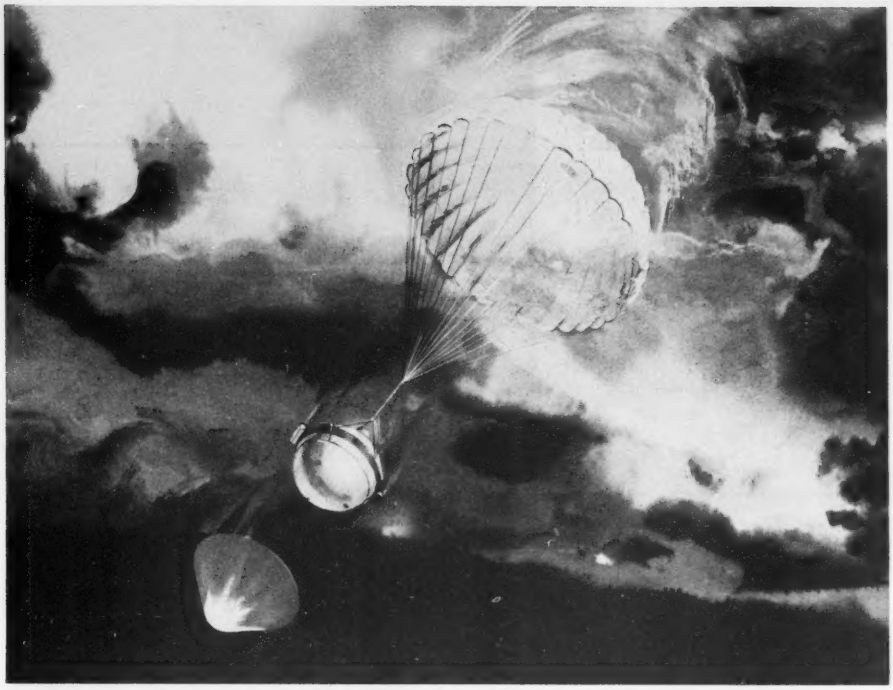
All four atmospheric probes are geometrically similar. The main component of each is a sperical pressure vessel which houses instruments, communications, data, command and power systems. The large sounder probe weighs about 316 kg and its seven instruments weigh 28 kg. It is about 1.5 meters wide. The smaller north, day and night probes weigh 93 kg each, and their three experiments weigh 3.5 kg. Each of the smaller probes is 0.8 m in diameter. All instruments within the probe pressure vessels require either observing or direct sampling access to the hostile atmosphere, one of the most difficult technical problems of the mission.

NASA's Office of Space Science has given project management of the two Pioneer Venus spacecraft to the Ames Research Center, and the spacecraft will be controlled continuously from the mission operations center at Ames. The satellites were built by Hughes Aircraft Co., of El Segundo, Calif., and the scientific instruments were supplied by NASA centers, other government organizations, universities and private industry.

The spacecraft will be tracked by NASA's Deep Space Network, operated by the Jet Propulsion Laboratory, a government-owned facility managed for NASA by the California Institute of Technology. NASA's Lewis Research Center is responsible for the launch vehicle, which was built by General Dynamics of San Diego, Calif.

Cost of the two Pioneer Venus spacecraft, scientific instruments, mission operations and data analysis is about $180 million. This does not include cost of launch vehicles and tracking and data acquisition.

Enticing Planet—This view of Venus was taken from 720,000 kilometers away by Mariner 10 TV cameras a day after the spacecraft flew past Venus enroute to Mercury in 1974. Pictures were taken in invisible ultraviolet light. The picture shows the predominant swirl at the South Pole of the planet.



Venus Sampler—How a probe will look when the red hot nose cone separates as the sampling device enters the planet's atmosphere.

All about Venus

Venus, the second planet from the Sun, is the closest to Earth. Because of its highly reflective cloud cover, Venus is the brightest object in the sky, second only to the Sun and the Moon. A year on the cloud-shrouded planet equals 225 Earth days. Mean distance from the Sun is 108.2 million kilometers, or about three-quarters of the distance from Earth to the Sun.

When Venus is closest to Earth, directly between Earth and Sun, the planet is only 42 million km away. Earth and Venus are almost twins in size and mass, but they are extremely different in other ways. As we know, Earth is a water-rich planet on which life thrives, while Venus is a dry, hot and desolate world, apparently without life. Scientists want to know how two such similar planets can have evolved so differently and whether there is any chance of Earth becoming like Venus.

Available evidence suggests that Venus has a dramatically rugged surface, but is less mountainous than Earth and Mars. Its surface temperature is hotter than the melting points of lead and zinc, about 485 degrees C, and the atmospheric pressure is about 100 times that on Earth. Surface features on Venus can never be seen because of its permanent cloud cover, and the atmosphere of Venus appears to be predominantly carbon dioxide—about 97 percent, with only tiny amounts of water vapor.

Venus has no significant magnetic field, therefore the upper atmosphere of the planet interacts directly with the solar wind, and it is one of the planets in our solar system that has no moons (the others are Mercury and Pluto).

The mass, diameter and mean density of Earth and Venus are almost identical, and high overall density on Venus suggests a dense core resembling Earth's nickel-iron core. Venus receives almost twice as much solar radiation as Earth. As a result of the entrapment of solar heat by its atmosphere and of the global atmospheric circulation, surface temperatures are uniformly high, including the planet's polar regions that otherwise would presumably have habitable temperatures. This trapping characteristic is called a "greenhouse effect"—Venus' atmosphere allows the entrance of incoming solar radiation, but restricts radiation of heat outward. In addition to carbon dioxide and water traces, the atmosphere of Venus also has some carbon monoxide, hydrochloric acid and hydrogen fluoride.

Permanent clouds on the planet are persistent, somewhat like terrestrial smog, and almost twice as deep as Earth's cloud layer. They measure about 18 km thick and are believed to be composed mainly of sulfuric acid droplets. Somewhere below the bottom of the main cloud layers, the temperature becomes high enough for the sulfuric acid droplets to evaporate, resulting in a clear atmosphere. When that happens, enough sunlight gets through the cloud to make the surface appear as bright as Earth on an overcast day.

The Pioneer flights may shed new light on some of the most puzzling questions concerning planetary science.

NASA Launches Satellite for ESA

The second Geostationary Scientific Satellite (GEOS–2) was sent into orbit by NASA for the European Space Agency from Cape Canaveral, on July 14. Under an agreement between the United States and ESA, the satellite was launched by the Delta 2914 launch vehicle which is managed by the Goddard Space Flight Center, ESA will reimburse NASA for cost of the Delta launch vehicle, launch services and other administrative costs totaling $16.5 million.

The GEOS–2 launching marked the 143rd flight mission for Delta. Of the previous 142 launchings, 131 were successful for a better than 90 percent launch record.

GEOS–2 will study the magnetosphere, that region of near-Earth space where the magnetic field of the Earth still plays a dominating role. The magnetosphere prevents direct access of energetic solar particles to the Earth and thus protects our planet from the harmful effects of space radiation.

The satellite's position above the equator will be shifted between 9 and 35 degrees east longitude during the first year of operation for the utmost efficiency in correlating satellite data with ground station, balloon and sounding rocket measurements made on the same magnetic longitude.

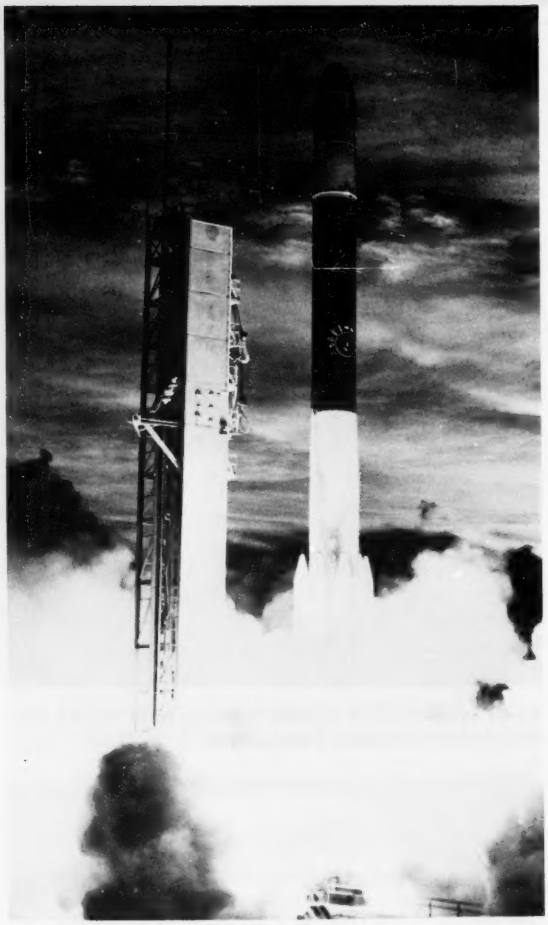
GEOS–2 will carry out the mission originally conceived for GEOS–1, which did not achieve a proper orbit April 20, 1977, because of a premature separation of the Delta second and third stages. The malfunction was caused by a failure of the separation bolts. Different bolts with greater reliability are now used. The GEOS–1 spacecraft was placed in a 12-hour elliptical orbit by the European Space Operations Centre at Darmstadt, West Germany, a modification that achieved at least some scientific return.

The cylindrically shaped GEOS–2 weighed 573 kilograms at liftoff (including experiments, apogee boost motor and propellant). It was designed for a two-year lifetime.

Except for minor modifications to certain spacecraft subsystems, the seven GEOS–2 experiments are the same as those aboard GEOS–1. They were provided by 11 research institutes in eight ESA member countries (Denmark, France, Germany, Italy, Netherlands, Sweden, Switzerland and the United Kingdom).

The European Space Operations Centre at Darmstadt—about 35 km northwest of the Odenwald ground station—is responsible for all orbital operations of GEOS–2. This includes the firing of the satellite's solid propellant motor approximately 36 hours after liftoff, placing the satellite into its final stationary orbit 35,750 km above the equator and the African continent.

The Delta program is managed by the Goddard center for NASA's Office of Space Transportation Systems. Launch operations are the responsibility of the Kennedy Space Center Expendable Vehicles Directorate. Prime contractor for the Delta launch vehicle is McDonnell Douglas Astronautics Co. of Huntington Beach, Calif.



The GEOS–2 at time of launch.

Egypt to Put Small Payloads Aboard Space Shuttle

The Egyptian government has reserved four small self-contained payloads to be flown on the Space Shuttle in the 1980s. At a NASA headquarters ceremony hold last July 13, Dr. Mohamed Shaker, Minister of the Embassy of Egypt in Washington, D.C., and Dr. Farouk El-Baz, Research Director for the Center for Earth and Planetary Studies, Smithsonian Institution, presented NASA officials with a down payment to reserve Shuttle space.

The payloads, commonly called "getaway specials," can weigh no more than 90 kilograms and be no larger than .5 cubic meters. They are flown on the Shuttle on a space available basis for scientific research and development purposes.

The small payloads must require no additional Space Shuttle services such as electrical power or deployment in space. Each payload reservation requires a $500 down payment. To date, payments have been made to NASA for some 240 small payloads. Purchasers include private individuals, commercial firms and foreign countries.

The Egyptian purchase marks the first foreign educational use of the payloads program. Egyptian students will compete in a nationwide contest by submitting proposals for an experiment to be flown aboard Space Shuttle missions. Evaluation of the proposals will be under the direction of El-Baz, who also serves as an advisor on scientific matters to Egyptian President Anwar Sadat.

Egypt Participates in Shuttle Program—Dr. Mohamed Shaker, Minister of the Egyptian Embassy in Washington, D.C. presents a $2,000 check to Donna Skidmore, manager of the Shuttle "Getaway" program, payment to reserve four small self-contained payloads to be flown on the Space Shuttle. Other participants, l. to r., are: William G. Bastedo, director of international program support at NASA; Phillip E. Cubertson deputy associate administrator for space transportation; Capt. C. M. Lee, director of space transportation systems; and Dr. Farouk El-Baz of the Smithsonian Institution.

Detective Story, Part Two

Although the "Shroud of Turin" investigation by JPL scientists is not a NASA enterprise, the image enhancement techniques used stem from space technology. The work, therefore, has a NASA connotation. The following article, from the JPL Universe, covers the latest developments in this fascinating story. (See NASA Activities *for November 1977 for earlier coverage.)*

The Shroud of Turin—that ancient burial cloth mysteriously imprinted with a figure thought to resemble Jesus Christ—is dramatically affecting the lives of two JPL scientists.

When Don Lynn and Jean Lorre agreed to apply image processing techniques to photographs of the shroud in 1977, they hardly expected to find their results published in newspapers and magazines around the world.

One of the Shroud of Turin "Detectives"—Don Lynn, one of the two JPL scientists who have become deeply involved in the international investigation of the religious relic.

Since then, their initial mild curiosity about the relic has intensified through involvement with other American scientists who propose to determine how the shroud was imprinted through a variety of sophisticated tests. The result is that Lynn and Lorre will go to Turin, Italy, in October when Catholic authorities will allow the American science team to make an unprecedented 24-hour examination of the shroud itself.

The team is sponsored by the New York-based Holy Shroud Guild of America. And the tests coincide with a public exhibition and international conference about the shroud, to be held in Turin Sept. 26 through Oct. 8.

Lynn and Lorre will take infrared and ultraviolet photographs as well as conventional black and white and color pictures. Other team members will make radiographic and X-ray fluorescence examinations.

Primarily, they will explore the mechanical formation of the unique "negative" image of a 5-foot-

10 man with lacerations about his head, face and body.

Turin authorities declined to accept the proposed age-dating tests until it is determined exactly how much cloth is needed to get accurate results. If approval is granted by the conclusion of the exhibition, results from those tests will take months to obtain.

Although the shroud has been stitched to a protective cloth backing, the reverse side of the fragile fabric will be examined also, by using a flexible optical instrument.

A special frame from which the fabric will be suspended with magnets has been designd by Tom D'Muhala, president of an international nuclear decontamination firm in Connecticut. D'Muhala's chance reading of a book about the shroud led him to build and donate this equipment and to supervise logistics of the team's trip to Europe.

A formal proposal for the examinations was sent to authorities in Turin, along with a model of the frame and a unique three-dimensional model of the shroud figure, derived from image enhancement photographs.

Based on the relationship between image intensity (shades from black to white) and cloth-body distance, Air Force Academy professors and students built a cardboard model of the shroud's figure. They used slices of ⅛-inch-thick cardboard to build up layers (similar in appearance to a topographical map) that form the frontal image of a 5-foot-10 man in a state of repose.

As the day of examination approaches, financial support for the American science team is still uncertain. "But we're going ahead with our plans," says Lynn, "because we are certain the funding will come from somewhere."

The cooperation of major business corporations has been tremendous, Lynn reports. Photographic and electronic equipment companies, including Polaroid, Kodak and the Brooks Institute of Photography have agreed to lend or donate facilities and equipment for the tests.

All the participants are donating their time, but money is needed for purchasing some equipment and for transporting people and equipment to Turin. Funds also are needed for the months—possibly years—needed to analyze the data.

Lynn and Lorre expect to provide a "quick look" report of their findings soon after the Turin exhibition. Both men speak of the event with expectation—still in awe of witnessing how technology is unlocking closed doors of history.

Electricity from the Sun to Aid African Villagers

A solar cell powered water pump and grain grinder will soon be relieving villagers of some of their daily burdens in the remote village of Tangaye, Upper Volta, in West Africa. At present, the women and children of the village draw water twice a day by hand from wells as deep as nine meters. The women also prepare flour for each meal by pounding grain with a primitive mortar and pestle, then by hand-stone grinding. The task generally requires about two hours a day.

The installation of a water pump and grain grinder powered by a solar cell system promises to change all that. Under the terms of a cooperative agreement between the U.S. Agency for International Development and NASA, AID will provide the funds to purchase all necessary hardware including the solar cell array, pump and grinder.

The Lewis Research Center will provide the necessary manpower and technical management to design, fabricate, install and monitor the system. The project will last about a year and a half, taking several months to set up the system and one year for experimental operation, after which, the system will continue to be used by the villagers indefinitely.

According to Dr. Louis Rosenblum, chief of the solar and electrochemistry division at Lewis, "When the solar cell power system is completed in December 1978, it will be capable of providing 1.8 kilowatts (peak) of electricity. The water pump will be able to supply 4,542 liters of water per day. The grinder will cut the time required to produce flour from two hours to 10 minutes per family."

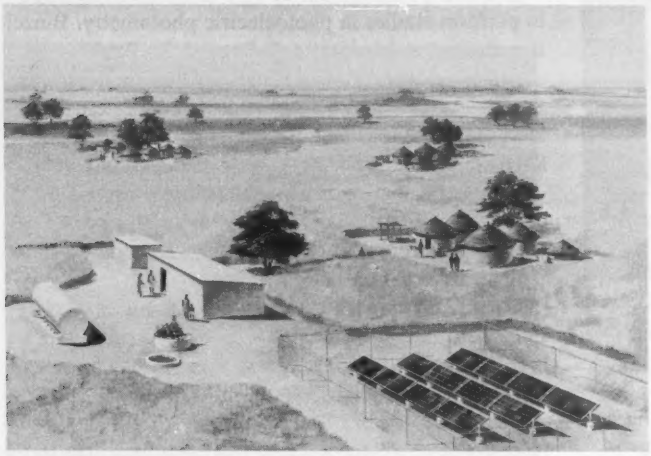
Upper Volta is located south of the Sahara Desert in the semi-arid portion of West Africa (the Sahel). Tangaye is located about 120 miles east of the capital city, Ouagadougou. The rainy season in the Sahel is July through September and water is a precious commodity. Several wells are located throughout the village, but only one maintains water as the others gradually dry up. It is this well that will be improved and outfitted with the new pump.

This cooperative AID-NASA project, which is part of an AID program to study energy needs in the food systems of lesser developed countries, also will address the socio-economic effects of reducing the time the women need to grind grain and draw water.

"There are more than 3 million villages without electric power in the world today," says Rosenblum. "The success of the experiment at Tangaye is bound

to influence the direction taken by other developing countries to satisfy the pressing energy needs of their large rural populations."

The Lewis center has been engaged in transferring space-related solar cell technology to terrestrial applications since 1971. Most of this work in recent years has been assigned and funded by the Department of Energy. The Lewis technology transfer has included raising solar cell efficiency and reducing cell and array fabrication costs as well as demonstrating solar cell systems in various applications. Solar cell arrays are still relatively high-priced, but the total life-cycle cost today of solar cell power systems for remote locations and lesser developed regions, such as West Africa, is considerably lower in many cases than the cost of fuel and transportation for alternate power sources.



Modern Life-style to Be Introduced—The West African village of Tangaye (as an artist sees it) by yearend will be pumping water and grinding grain from electricity generated by the solar cell array shown in lower right.

Space Observance Days Celebrated in Two States

Gov. George C. Wallace declared July 16 to 24 as Alabama Space Observance Days in honor of the State's involvement in national Space effort. The same period was observed as Space week in Texas by order of Gov. Dolph Briscoe. The dates coincided with the ninth anniversary of the 1969 Apollo 11 mission, when men first walked on the surface of the Moon. Apollo spacecraft were boosted into space by Saturn V launch vehicles developed at the Marshall Space Flight Center.

NASA administrator, Dr. Robert A. Frosch said in a statement from NASA headquarters: "It is exciting to consider what is happening in space during this anniversary period. Considering the level of our present activity, and the prospects and promise of space for the expansion of human knowledge and the improvement of the human condition, a degree of healthy enthusiasm and advocacy is inevitable in those of us who are involved."

Gov. Wallace's proclamation noted the Marshall center's current role in developing the reusable Space Shuttle, as well as "the generation of electrical energy from the Sun . . . and the forthcoming processing in Earth orbit of special materials for medical and other purposes."

Wallace stated that in the process of exploring space "the United States has developed many new industrial and scientific capabilities and new technologies have evolved from space activity which have had a profound and positive impact on our daily lives."

He pointed out that the space program brings countries closer together as nations cooperate in their efforts to advance the knowledge of mankind. "The State of Alabama and its Marshall center are taking leading roles in these advances with the Marshall center now groundtesting the Space Shuttle, the next-generation carrier which will be the instrument of a broad range of space research and application in coming years."

Texas Gov. Dolph Briscoe stated that: "The United States space program and its technology directly and indirectly benefit relations among countries, astronomy, medicine, business, air and water cleanliness, urban development, industry, agriculture, law enforcement, safety, communications, the study of earth resources, weather forecasting and education . . .

"The National Aeronautics and Space Administration and the Johnson Space Center, in the highly successful completion of the Apollo program and those precedent to it, contributed much to the prestige of Texas as a scientific and technological center, and have at the same time established their operations as an integral part of the State's economy, providing valuable employment for our workers and a reservoir of technology for business and industry. . .

"On July 20, 1969, an Apollo spacecraft, controlled from Houston, touched down at Tranquility Base, carrying the first men to set foot on the Moon."

Students Win Viking Grants

Ten grants, totaling $5,000—for the support of research projects in planetology and astronomy—have been awarded to eleven students by the scientists of NASA's Viking Project.

The money is part of the annual Newcomb Cleveland Award, presented by the American Association for the Advancement of Science last February to 150 scientists who participated in the Viking landings on Mars.

"In selecting these proposals, we are expressing a belief that these students can make a noteworthy contribution to the fields of planetology and astronomy," said Dr. Gerald A. Soffen, former chief of the Viking scientists.

Soffen and Cary R. Spitzer, Viking project deputy manager, selected the ten winners from among 71 proposals submitted by college and high school students from the United States and several foreign countries.

No time limit is set for completion of the projects, but brief progress reports will be made periodically to the Viking project office. As each project is completed, a brief article will be prepared for publication in an appropriate scientific magazine or journal.

Winners and their projects are:

Kenneth W. Jeffreys, Springfield, Mo., received $900 to observe and analyze eclipsing binary systems. Jeffreys is a student at Southwest Missouri State University in Springfield.

Sandy F. S. Chun, La Canada-Flintridge, Calif., received $750 to study photocatalytic oxidation of organic compounds. Chun is a student at Pomona College, Claremont, Calif.

Michael J. Matheson and August Ochabauer, Palatine, Ill., received $665 to perform a chemical and petrographic analysis of the Plainview meteorite. They are students at Harper College in Palatine.

Robert Shaw, Los Angeles, Calif., received $600 to study selection effects concerning supernova detection. Shaw is an astronomy student at the University of Southern California in Los Angeles.

David C. Jewett, Hertfordshire, England, was awarded $500 to construct an apparatus to observe transient lunar phenomena. Jewett is a student at University College in London.

Richard P. Binzel, St. Paul, Minn., received $500 to perform studies in photoelectric photometry. Binzel is a student at McAlester College in St. Paul.

Mark Selover, Shaker Heights, Ohio, will use his $450 grant to construct a low-cost radio telescope. He graduated in June from Shaker Heights Senior High School.

Sam S. Mims, Baton Rouge, La., will use his $235 grant to compare color index with brightness variations in asteroids. Mims is a student at Louisiana State University in Baton Rouge.

Carter B. Emmart, Demarest, N.J., will study stellar ultraviolet, blue and visible photometry with his $200 grant. Emmart is a student at Northern Valley Regional High School.

Seth S. Horowitz, Scarsdale, N.Y., received $200 to perform space technology studies in the area of magnetohydrodynamics. He graduated in June from Scarsdale High School.

Postal Stamp Honors Viking Missions

The Viking missions to Mars were commemorated by the issuance of a special postal stamp on July 20, the second anniversary of the Viking 1 landing on Mars. A "First Day of Issue" ceremony, sponsored by the U.S. Postal Service and NASA's Langley Research Center was held in the Langley activities center. Langley Director Dr. Donald P. Hearth bought the first stamp.

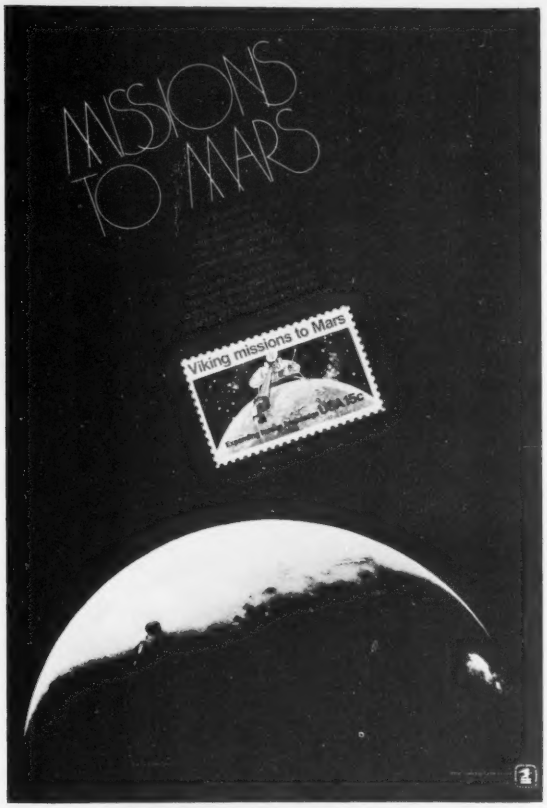
A temporary post office was established for the day at the Langley picnic area near the activities center, and the new Viking 15-cent stamp was sold to the public and cancelled for collectors by Hampton postal workers.

The special Viking stamp went on sale July 20 at the Hampton Post Office; national sales began July 21.

The Viking stamp was designed by Robert T. McCall, well known space artist, who has designed several other stamps with space themes. Two of his large murals are on display at the National Air and Space Museum in Washington, D.C.

NASA does not have an official cachet for the Viking stamp, but several philatelic organizations and individual collectors had their own cachets for sale during the day. A special area near the temporary post office was set aside for these sales.

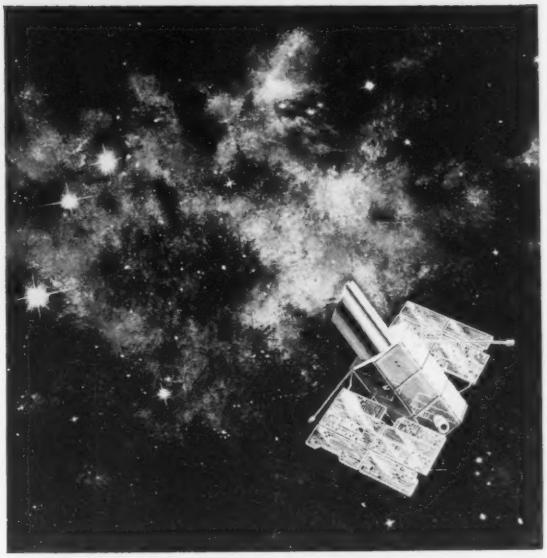
The two Viking spacecraft were launched toward Mars in August and September 1975. Viking 1's Lander craft touched down on Mars at 8:12 a.m. EDT July 20, 1976, and the Viking 2 Lander reached the planet's surface at 6:59 p.m. EDT, Sept. 3, 1976.



Item for Philatelists—"Stamp Collecting for the Fun of It," U.S. Postal Service poster #398 hangs in post offices throughout the country.

Copernicus Finds Second Black Hole

After a two-month search, the Goddard Space Flight Center's Copernicus satellite has located what may be a second invisible "black hole" in the universe in the constellation Scorpio. The satellite's X-ray experiment found the black hole, believed to be a super-dense collapsed star with such strong gravity that not even light can escape it.



Black Hole Detector—The Copernicus satellite's X-ray experiment located the new black hole in the constellation, Scorpio. Artist's drawing shows the six-year-old astronomy satellite in orbit above the Earth.

"This is the second black hole found in our galaxy," said co-investigator for the project Glen Pollard. "It is much more active and convincing than the first, Cygnus X–1."

The invisible black hole is orbiting Scorpio V–861, a super giant star which can be seen with the naked eye from Earth. It is gradually siphoning away the larger star's atmosphere.

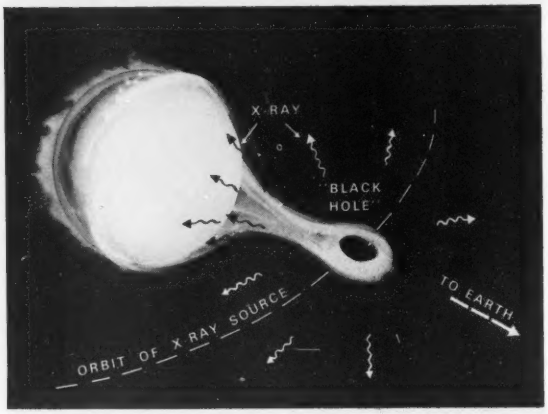
The massive amounts of X-rays released from matter as it is transported from the giant star led the scientists to what another co-investigator, Ronald Polidan, calls "the best black hole yet."

Most importantly, the scientists say, the discovery has given astronomers their first opportunity to study a black hole as it passes behind its companion star. The new data will give astronomers a chance to test some of their black hole theories. Pollard hopes the new information will define the shape of the cloud of stellar material being sucked into the black hole, thus revealing some of the dynamics of black hole systems. It also may provide a measure of the quantity of material being removed at speeds up to 3.2 million kilometers per hour.

Studying black holes also will extend astronomers' knowledge of physics into realms of laws not observable on Earth—the Physics of Relativity.

Teams of scientists at Goddard, from Princeton

University and University College of London, conducted the search specifically for black holes. The universities co-operate with NASA's Copernicus satellite, which was launched almost six years ago.



Space Phenomenon under Study—The structure of a black hole as envisioned by scientists shows the gas clouds of a visible star swirling around and into the X-ray source or black hole. It sucks in vast quantities of matter as it orbits the star. A black hole, Cygnus X–1, located in 1973, was estimated to be three times denser than our Sun, but less that a fiftieth its size.

NASA Uses Computer to "Witness" Cosmic Events

Using the world's most powerful computer as a miniature universe, scientists are now "seeing" the birth and evolution of stars and galaxies, including our own, through experiments being carried out at the Ames Research Center.

Two hundred million years are being compressed into several hours, computer time, and the distance light travels in 100,000 years is reduced to the length of a television screen to permit program personnel to witness galaxies collide and gas clouds beget embryonic stars. These simulated cosmic events threaten to alter traditional ideas of how galaxies form, what shapes they assume, and what happens when they collide.

Elliptical galaxies were thought to be oblate, or Frisbee-shaped, but computer-generated elliptical galaxies by scientists at the Ames center reveal their three-dimensional shape to be prolate, or oblong. And astronomers are lately reporting observational evidence confirming the computer's discovery.

It is beginning to appear to involved Ames researchers that computer simulation of cosmic events is an important factor in fully understanding the dynamics of the universe. An astronomer now has a "laboratory" to test his theories and conduct his experiments.

A scientific team at Ames led by University of Chicago astronomer Dr. Richard Miller and Ames astrophysicist Dr. Bruce Smith are instructing Ames' Illiac IV computer—the world's most powerful—to create swirling systems of 100,000 computer points. Each point represents the mass of about one million of our Suns to give the simulated galaxy a realistic total mass. Each point "feels" the gravitational tugs of its neighbors and "absorbs" energy from exploding supernova.

Over the past few years, Miller and Smith have developed a detailed computer program to study the formation and dynamics of galaxies. They couple this code with the computational power of Illiac IV, to accomplish computer simulation. Miller and Smith routinely follow up to 120,000 "stars" which are free to move about in a "cube"—a three dimensional boundary of space created by the computer, corresponding to 100,000 light years from edge to edge. They can order Illiac IV to rotate the cube so they can watch events from every angle. They can look up at swirling dust clouds or peer down at gigantic galaxial collisions.

Galaxies at Their Fingertips—Dr. Richard Miller (foreground) and Dr. Bruce Smith, researchers at the Ames center, follow two computer-simulated galaxies set on a collision course. Use of the computer as an astronomical "lab" may be a key to fully understanding the dynamics of the universe.

Scientists at Ames have filmed several computer simulations. These films reveal unusual events that seem to run counter to traditional theories of astrophysics. For example, vast congregations of computer-generated stars repeatedly evolve into stable prolate bars. These bars are seen to rotate end over end like a football and may be the true shape of elliptical galaxies.

The Ames team suggests that elliptical galaxies seen through the telescope are really the same prolate bars generated by the computer but seen in various projections. Ordinarily astronomers view snapshots of galaxies projected onto the sky. They have only one view of the galaxy and can only guess its shape, since it would take millions of years to track the galaxy across the sky and view it from a different perspective. But with a powerful computer, they can "examine" such galaxies from every direction and easily visualize their three-dimensional form.

When Miller and Smith set two 50,000-star galaxies on a collision course, they saw much greater interaction between the colliding galaxies than was forecast. The galaxies first were seen to contract, with their gravitational fields reinforcing each other. Then they bounced back in a violent expansion that flung hundreds of stars out of the galaxies. The end result was a merger of the two galaxies but with considerably fewer stars.

Curiously, spiral-shaped galaxies such as the one to which Earth belongs, never appear for long without assuming the prolate bar shape. This perplexing situation means that the present state of knowledge concerning the physics of spiral galaxies is inadequate, and that other basic physical processes probably play a role in the formation of stable spiral galaxies.

Ames researchers are presently following simulated masses of gas as they coalesce and form stars. Some stars are programmed to have a short life, collapsing into brilliant supernova eruptions, spewing their masses out into the primordial galaxy. In this area, too, Miller and Smith are expecting surprises from Illiac IV. Perhaps more theories concerning the nature and evolution of the universe may change as the gigantic computer reconstructs events which took place at the beginning of time.

Second Wind Turbine Dedicated

The Federal government's second large wind turbine generator to be field tested by a U.S. utility was dedicated in July. The event took place on the small Puerto Rican island of Culebra, about 80 kilometers east of San Juan. The outdoor ceremony was attended by Puerto Rico's governor Carlos Romero Barcelo and officials from the Department of Energy, from NASA headquarters and from the Lewis Research Center, which developed the wind turbine for DOE. Also present were officials of the Puerto Rico Water Resources Authority, which will operate the experimental wind turbine, members of the Puerto Rico legislature and government, and officials of the Westinghouse Electric Corp., which assembled the wind turbine.

The Culebra wind turbine has two rotor blades spanning 38 meters, and produces 200 kilowatts of electric power in winds of 29 to 60 km per hour measured 9 m above ground level. It is expected to produce the equivalent of 20 percent of Culebra's electric power, or about enough power for 150 island homes. The Water Resources Authority will operate the turbine for two years, supplying test data to DOE and NASA. The purpose of the test program is to help determine the performance and economics of large wind energy systems used by utilities.

The Culebra wind turbine was dedicated about six months after the dedication of an almost identical wind turbine at Clayton, N.M., a small farming and ranching community. The Clayton wind turbine has completed the first quarter of its two-year test program, supplying more than 100,000 kilowatt hours of electric power to the town's municipally owned utility.

Both wind turbines are upgraded versions of the 100-kilowatt prototype machine designed and built by the Lewis center at its Plum Brook facility in 1975. That wind turbine is now being used to test advanced wind system concepts and components. A third 200-kilowatt machine, similar to the earlier two, is expected to be tested on Block Island, R.I., early next year. Late this year, a much larger wind turbine—rated at 2,000 kw and furnishing enough electric power for more than 500 homes—is expected to become operative near Boone, N.C.

Successful use of wind power in Puerto Rico could help reduce present total dependence on imported oil. Culebra Island currently receives electric power by underwater cable from an oil-fired plant on the main island. Before that, Culebra operated its own small oil-fired generators.

Thunderstorm Research Group Summers at KSC

Eighty of the nation's leading atmospheric physicists and lightning researchers spent the summer studying the electrical properties of thunderstorms at the Kennedy Space Center.

Known as the Thunderstorm Research International Program (TRIP), the study makes use of the spaceport's unique meteorological facilities—built up during the Apollo and Skylab programs for assessing thunderstorm hazards during launch operations—and the high incidence of lightning-charged storms that strike the area during the summer months.

Bill Durrett, chairman of NASA's Kennedy center lightning team, said, "We have a belt that runs right across the state from Tampa on the West Coast to Fort Lauderdale on the East Coast, and that belt produces the hottest storms in the world."

Durrett said the center section of the state receives between 75 and 90 thunderstorm days each year.

The individuals involved in the study are members of many of the country's top educational institutions and research organizations—including 10 universities, two research laboratories, the National Oceanic and Atmospheric Administration and three other NASA Centers in addition to KSC.

The university researchers are funded by the Office of Naval Research and the National Science Foundation. KSC provides its meteorological instrumentation, facilities of the local National Weather Service office and normally available support services such as power, communications and film processing. Personnel from KSC's technical support directorate assist the investigators in selecting and setting up their experiment sites. Angelo Taiani, of the Kennedy operations support management office, was project coordinator of TRIP '78.

The TRIP study was first conducted at KSC in 1976, born of the concept that much more knowledge about the phenomena that cause electrical charges in clouds can be brought out by having many investigators study the same storms in the same area.

By acting as host to the study, KSC profits, since many of the lessons learned will be applied in future Space Shuttle launch and landing operations.

Many of the experiments employed instruments brought to KSC by the participating investigators, including ground systems and instrumented aircraft. The scientists also used many of KSC's instrumentation systems, including one developed during the Apollo program for detection of buildup of electrical charges in overhead thunderclouds that might interfere with space vehicle launch operations; NASA–6, the spaceport's instrumented aircraft used in previous lightning studies; and the lightning detection and ranging system, which detects electrification in distant clouds. NOAA's Geosynchronous Operational Environmental Satellite provided satellite photographs for scientific use.

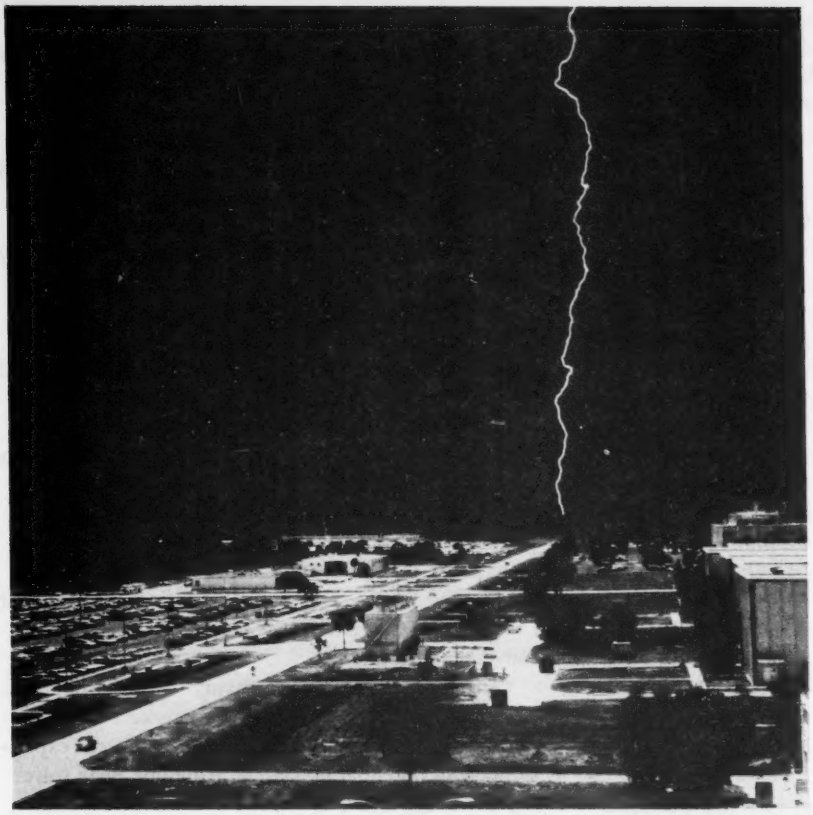
Services of the NOAA National Weather Service office of KSC and the Air Force Weather Service office at Cape Canaveral Air Force Station were made available to the researchers. Daily forecasts and briefings were given of the probability of electrically charged clouds causing lightning strokes in the KSC vicinity.

Among the more interesting studies is one centered on the evaluation of prototype lightning sensors that will be part of the scientific package to be flown on the Jupiter Orbiter Probe in 1982. That mission, formally designated as Project Galileo, will feature the first planetary spacecraft to be carried aboard the Space Shuttle. Galileo will conduct the deepest scientific investigations yet of Jupiter, its environment and moons, including the first direct measurement of the planet's atmosphere. An Earth-based lightning detection system developed by two TRIP principal investigators, who also are co-investigators for Project Galileo, will be used to check the accuracy of the prototype version of the Jupiter-bound sensors.

Other experiments included the study of overall evolution of lightning activity; examining the structure of waveforms radiated from lightning for characteristics indicative of storm type, specifically, to determine whether or not tornado bearing storms can be identified on the basis of the radio frequency radiation associated with the storm system; obtaining range and azimith data for lightning strokes by use of ground based systems; monitoring electric field and corona (surface discharge of electricity) current over water; and study of precipitation formation and development in thunderclouds as those factors relate to lightning occurences.

Several researchers used airborne instrumentation to gather data. The NASA–6 aircraft was used to assist ground instrumentation in locating clouds and to determine and record electric field intensity in selected clouds.

KSC conducted two investigations of its own during TRIP '78. In the first, the lightning detection and ranging device was used to locate electrically



Big Strike—One of the spectacular lightning bolts, this one extending from 1,200 meters to 0-m (ground level), that make the Florida area near Cape Kennedy a logical site for summer-storm study. In this photo, taken by Dr. Richard E. Orville of the State University of New York (principal investigator during TRIP '77), the camera faces due west; KSC buildings are in right foreground.

active areas of a cloud and map the space-time history of electrical discharges, to determine the physical relationship between electrically active areas and rain areas of a cloud, to detect and locate lightning strikes to the ground, and to gather evidence that VHF radiation ceases just before cloud-to-ground contact and resumes after the return stroke has been established.

In the second experiment, KSC, working with University of Florida personnel, used television cameras to locate the coordinates of all cloud-to-ground lightning flash ground-contact points. At the end of each storm day, video tapes of each storm were analyzed and presented to the principal investigators with a list of lightning times-of-occurence and ground-strike coordinates to aid with their data collection.

Although the Kennedy center is not scheduled to be the site for storm research after 1978, the program will not end. TRIP's 1979 study site will be at the Langmuir Laboratories, Socorro, N.M., where the emphasis will be on mountain storms of the southwest.

New Appointment in Engineering

Harry Sonnemann was named deputy chief engineer in June. As such, he will be responsible to the chief engineer for the management of program assurance, safety and engironmental health, and systems engineering.

Sonnemann came to NASA in October 1977 from the Office of the Assistant Secretary of the Navy (research and development), and since then has served as assistant to the chief engineer. In the Navy Secretariat, he held positions as special assistant for electronics and special assistant for anti-submarine warfare and ocean control from 1968 to 1977. He also was active in the development of large seismic arrays, holding the position of assistant director for field engineering in the advanced research projects agency's nuclear test detection office from 1964 to 1968. Before he entered government service, Sonnemann was assistant director of Columbia University Hudson Laboratories. There he served in various capacities as an electronic engineer, department head, and assistant director in support of underwater

acoustics and ocean engineering R&D projects.

Sonnemann is a native of Munich, Germany. He received his B.S. Degree in electrical engineering from the Polytechnic Institute of Brooklyn, N.Y. in 1954.

Forest Lookout Towers Providing Solar Electric Power

The nation's first solar electric forest lookout tower, dedicated last July on Antelope Peak in California's Lassen National Forest, demonstrates that modern technology can virtually duplicate the conveniences of home in the most remote locations.

Officials from the U.S. Department of Energy, the Forest Service of the U.S. Department of Agriculture and NASA's Lewis Research Center gathered atop the 2,392-meter peak to dedicate a pioneer lookout tower powered by solar cells as an illustration of what solar electric technology can mean for America in the foreseeable future.

Taking part were Dr. Harold L. Macomber, program manager, Division of Solar Technology at DOE; William J. Jones, forest supervisor, Lassen National Forest, Forest Service, USDA; and Dr. Louis Rosenblum, chief, Solar and Electrochemistry Division at the Lewis center.

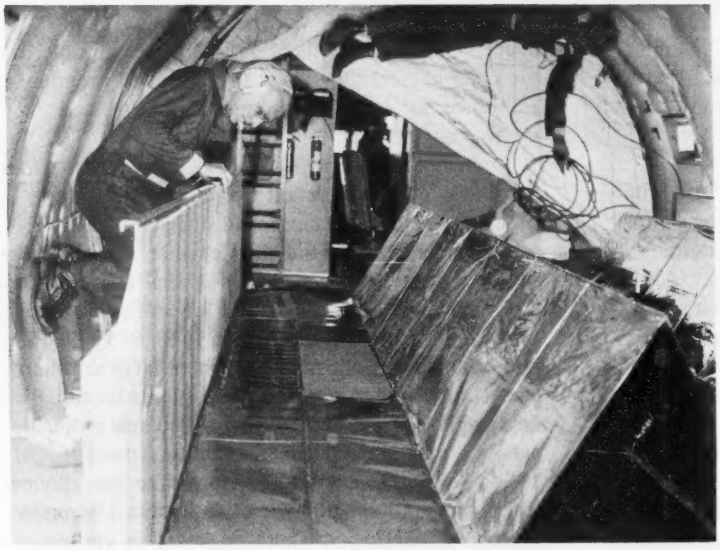
The 300-watt solar cell system provides complete electrical power for the tower's refrigerator, water pump, lights and radio communications equipment. In addition, the system powers other small appliances that make it possible for a fire lookout to live in the tower on a 24-hour basis.

The solar cells generate an electric current when sunlight strikes them, and that electricity charges 18 12-volt lead acid batteries specifically designed for solar electric use. The batteries can store up to 36 kilowatt hours of electric energy and thus can supply the tower's normal electrical needs for about a month before needing to be recharged.

In addition, unlike other types of on-site electrical power generation systems that could have been used by the Forest Service, the tower's solar electric power system is designed to operate uninterrupted for years, without fuel or periodic maintenance. With no moving parts, solar cells are a simple and reliable means for providing electrical power to the tower.

Funded by the DoE, the solar electric power system at Antelope Peak was provided by the Lewis center through the tests and applications project that Lewis manages as part of the DoE's photovoltaic conversion program.

"The NASA Lewis assignment," says Rosenblum, "is aimed at stimulating near-term markets for solar cell power through cooperative cost-shared experiments with potential users. The Antelope Peak tower is just one of a variety of applications now being tested throughout the country."



Dramatic Weight Loss—Floating inside NASA's KC–135 aircraft during a short period of near-weightlessness, engineers test a short section of lightweight solar array being developed for use in outer space. The very thin, flexible solar array section is 3.5 meters wide and 2.7 meters long when extended. Folded, the length is compressed to about .6 centimeter. With solar cells mounted on extremely thin material, the array cannot support itself in normal gravity, but by using the approximately 24 seconds of zero gravity provided by the aircraft, it can be extended or retracted to demonstrate that it will work properly in space. Bob Shurney (top), an engineer in the systems analysis and integration lab at the Marshall center and Don Griggs, a Johnson Space Center engineer, participated in the tests. Marshall is developing the solar array as a power source for systems in space. The complete array will be more than 30.5 meters long and started undergoing ground tests in June.

A forerunner of solar electric power systems of the future, the Antelope Peak tower is the first step toward other remote applications such as logging and trail camps, vacation cabins, hunting lodges and recreational vehicles, Rosenblum believes. "Virtually any remote, isolated area where conventional electrical power generation systems are deemed economically impractical would be an application candidate," he says.

Of the DoE photovoltaic program as a whole, Macomber states, "It is aimed at eventually obtaining a significant part of our nation's electrical power directly from the Sun's rays.

"Specifically, our mission is to reduce costs and boost production and use of solar electric devices and systems, such as the one at Antelope Peak."

According to Lewis officials, today's price of electricity generated by solar cell power systems over a 20-year system life, is about $1.75 per kilowatt hour. This price compares favorably with the price for alternate ways of generating electricity in remote areas, such as with diesel generators, where fuel, transportation and maintenance are expensive. DoE predicts that, by the turn of the century, increased use and production of solar electric power systems will have markedly lowered the present price and can thereby bring the benefits of solar electricity into the homes of every American.

The Antelope Peak lookout is the first of two solar electric-powered installations built for the Forest Service in California. The other, located atop Pilot Peak in Plumas National Forest approximately 95 kilometers south of Antelope Peak, became fully operational in late July. Constructed by Forest Service carpenters, the six-sided, two-story towers are a new design which the Forest Service hopes will eventually replace many older structures.

What benefit has the newly-turned-on solar electric power been to Virginia McAllister, fire lookout since 1972 on Antelope Peak? "In the old tower, I was totally reliant on Forest Service supply trucks for propane to power the tower's lamps and refrigerator," she says. "The forest net radio was powered by batteries but if I wanted a glass of water, or water to wash with, I had to raise it by hand myself. There was no shower or indoor plumbing either."

Today, all that has changed. As McAllister scans the horizon, she knows that the Sun which nourishes the forest is also providing the power which makes her life just a little bit easier.

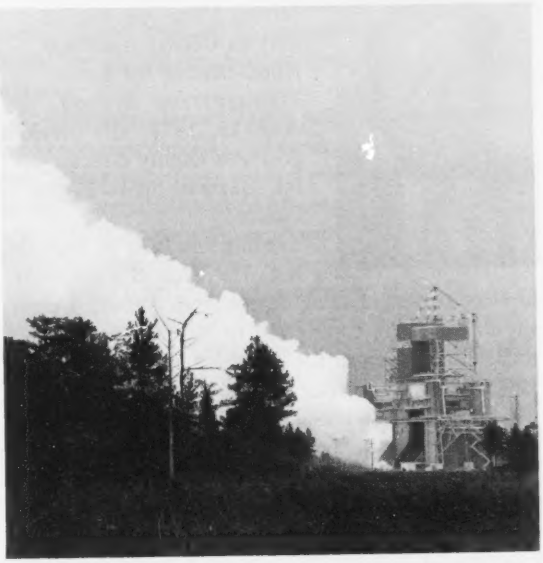
Goddard Essay Contest Opens

The National Space Club has announced the opening of the Robert H. Goddard Historical Essay Award competition for 1978. This annual nationwide competition, with a $500 prize, is open to any U.S. citizen.

The contest, named in honor of the rocket pioneer Dr. Robert Goddard, was the first literary competition devoted to historical affairs in the field of rocketry and astronautics.

According to the rules, essays "may bring new information to light or may cast a new and different light upon events and individuals influencing rocketry and astronautics in the United States." Entries should be submitted by November 1, 1978 to the Goddard Historical Essay Contest, c/o National Space Club, 1629 K Street, N.W., Washington, D.C. 20006. Persons interested should write the National Space Club for more information on the rules of the contest.

The winner, who will be announced at the awards ceremony in early 1979, will receive the Goddard Historical Essay Trophy Certificate and a $500 prize.



All Fired Up for Shuttle—The Space Shuttle main propulsion system was successfully static fired for 100 seconds on the test tower at NASA's National Space Technology Laboratories in early July. The firing was labeled a success by Bob Bush, space shuttle resident manager at NSTL. The three engines were fired at varying power levels up to 90 percent. The first series of tests ended July 7. Additional tests will begin this fall.

NASA and India Sign Agreement

Dr. Robert A. Frosch, NASA Administrator, and Professor S. Dhawan, Secretary, Department of Space and Chairman, Space Commission, Government of India, signed a memorandum of understanding July 18, for the launch of Indian National Satellite System-1. The first Insat–I launching on board the Space Shuttle is planned for the first quarter of 1981.

The memorandum defines the terms and conditions under which NASA will furnish launching and associated services to the Department of Space for the first generation of Insat spacecraft.

The Insat–I spacecraft will be the first of its kind, a multi-purpose vehicle that will be placed in geostationary orbit to provide domestic public telecommunication, and direct TV broadcasting and meteorology services for India.

This is the first such memorandum signed by NASA with a foreign governmental agency for provision of space transportation launch services on a reimbursable basis.

Indo-American Agreement—NASA Administrator Dr. Robert A. Frosch and India's Secretary of the Department of Space sign papers leading to the launch of an Indian satellite in 1981.

New Space Transportation Chief

Richard G. Smith began serving a one-year tour of duty as Deputy Associate Administrator for Space Transportation Systems, on Aug. 15, 1978. His previous post was deputy director of the Marshall Space Flight Center.

Smith was born in Durham, N.C. He received a Bachelor of electrical engineering degree from Auburn University in 1951. He transferred to NASA from the rocket R&D team at the Redstone Arsenal in July 1960, when the development operations division of the Army Ballistic Missile Agency became the nucleus for the Marshall center. He held various assignments in the former guidance and control laboratory and in the systems engineering office before his appointment as deputy manager and later as manager of the Saturn program. In January 1974, Smith became director of science and engineering and served in that position until he was named deputy director of the center.

Smith received NASA's Exceptional Service Medal in 1969 and Medal for Distinguished Service in 1973 for his contributions to the Apollo lunar program and the Skylab program.

Wind Turbine Undergoes Blade Inspection

After more than 1,000 hours of successful operation, the 200-kilowatt experimental wind turbine generator at Clayton, N.M., has been inspected to verify design life estimates. Its twin rotor blades are undergoing more detailed inspection at the Lewis Research Center. The center manages the large wind turbine portion of the Department of Energy's wind systems program.

The rotor blades and other dynamic components, which rotate at 40 revolutions per minute, have completed more than a million cycles since the machine began operating last January. A million cycles represents a significant technical measure of the characteristics required to prove that the machine can be expected to last 20 to 30 years.

The inspection showed that all components except the blades were wearing normally, but the blades had several loose or missing rivets and three small cracks, each less than three inches long. During inspection of the blades, the Clayton wind turbine was brought back on line using the rotor blades from a prototype wind turbine.

The Clayton wind turbine is the country's first federally sponsored wind system to produce electricity directly for a community power system. Since its dedication last January, the wind turbine has supplied more than 100,000 kilowatt-hours of electrical power for the city-owned utility system.

DoE's wind energy program is aimed at improving the technical understanding of wind systems, increasing wind systems' performance and reducing their cost, so that wind power can be used to reduce the nation's oil consumption.

Largest Wind Turbine Generator to Be Built

Ground has been broken on a North Carolina mountaintop for the country's largest wind turbine generator, scheduled for completion later this year. With its two 30-meter steel rotor blades, the wind turbine will produce 2,000 kilowatts of electric power in winds of about 39 to 64 kilometers per hour, enough to meet the needs of about 500 homes in and around the northwest town of Boone, N.C. When installed on its 43-m steel tower, the machine will be visible from Boone and from portions of the Blue Ridge parkway, which is traveled year-round by many campers, skiers and tourists.

This wind turbine will be the largest system to be field-tested by a utility under the Department of Energy's wind systems development program. The Lewis Research Center manages the large wind systems program for DoE. General Electric Co., Valley Forge, Pa. is the prime contractor for the Boone machine, which will be field tested by the Blue Ridge Electrical Membership Corporation.

In the coming weeks, workers at the site will pour the concrete foundation, erect the tower and construct an 85-m high meteorological tower to record wind velocity and direction at various heights.

Co-op Experiment on Pioneer Venus Ionosphere

Data from a joint U.S./German-developed experiment launched May 20 as part of the NASA Pioneer Venus mission could help to improve solar-affected communications on Earth. Called a retarding potential analyzer (RPA), the experiment is designed to sample and measure the temperature, concentration, and motion of ions and electrons in the Venusian ionosphere. It was developed by Lockheed Missiles & Space Co., Palo Alto Research Laboratory; Physikalishe Institute for Weltraumforshung, West Germany; and Messerschmitt-Bolkow-Blohn GmbH, West Germany.

Dr. William Knudsen, Lockheed's principal investigator, noted that "Existing information from Venus indicates that its ionosphere has a different ion composition from that of Earth, even though we would expect them to be similar since the planets have similar mass and crustal composition. New data on the composition and the dominant elements of the Venusian ionosphere, plus investigation into the fact that Venus has little or no magnetic field, could provide us with important information to understand the physics of our own ionosphere."

Earth's ionosphere acts like a giant reflector which bounces transmitted communications radio waves back and forth through the world, but solar phenomena such as flares and Sun spots sometimes affect our ionosphere's reflective ability and cause communications blackouts.

The RPA is carried abroad the Pioneer orbiter and will begin operation next December when the orbiter and a companion spacecraft approach Venus. Samples will be taken for 243 days through a 7.8-centimeter opening to space as the orbiter circles the planet. Wire mesh grids located at the front of the opening will be electrically energized to pass specific ions and electrons to a collector for measurement and analysis. An on-board computer will then process the data and transmit it to Earth for further analysis and interpretation by a team of scientists at the Lockheed research laboratory.

Gamma Ray "Burst" Detected

Scientists have now confirmed that Pioneer Venus 1, on the first leg of its seven-month voyage to orbit around Venus, detected an extremely powerful "burst" of gamma rays from somewhere in the universe.

So-called gamma ray bursts, unknown until 1973, have enormous energies and occur about once per month, seemingly from random points in our galaxy or even beyond. Discovering their origin—"black holes," brilliant supernovae, neutron stars or some totally unexpected source—represents one of astronomy's difficult tasks. Over the course of its 482-million-kilometer mission, Pioneer Venus' measurements of these puzzling bursts for the first time should enable scientists to accurately track their origins.

Designed to orbit Venus to study its weather processes, the Pioneer Venus orbiter spacecraft (Pioneer Venus 1) carries six interplanetary instruments, including a 2.8-kilogram gamma ray burst detector. The instrument's twin sodium iodide detectors sensed a "classical" two-second pulse of these very high energy photons just 33 hours after lift-off and 585,000 km from Earth.

Pioneer Venus 1 and its companion Pioneer Venus 2, are managed by NASA's Ames Research Center. Both will arrive at the cloud-shrouded planet in early December.

Two other American spacecraft also detected the gamma ray blast—Vela, a Department of Energy satellite circling the Earth and Helios B, a NASA-European scientific satellite orbiting the Sun. Scientists will correlate the observations of the Venus orbiter with data collected by these satellites to obtain a rough "fix" on the burst. As Pioneer Venus 1 speeds toward Venus, away from Earth satellites, such "triangulation" techniques will pinpoint the origin of gamma ray bursts with ever-increasing accuracy.

Ideally, measurements of the gamma ray sources will be made with an accuracy of less than one minute of arc, precise enough for an attempt at identifying the source with powerful optical or radio telescopes on Earth. By locating the origin of the bursts (probably within our own galaxy), scientists hope to deduce what extraordinary physical events produce these enormously high energy explosions. None of the hypotheses proposed in the past few years satisfactorily accounts for the gamma ray bursts.

One popular theory suggests the existence of binary star systems involving a star like the Sun and an extremely dense entity such as a "black hole," so termed because not even light can escape its incredibly strong gravity field. "Bursts" occur when chunks of stellar material flowing from the star fall into the black hole. This event ignites thermonuclear explosions much like hydrogen bomb blasts and gives off high energy gamma rays which streak across the universe at the speed of light. The leading candidate for such a system is Cygnus X-1 in our galaxy.

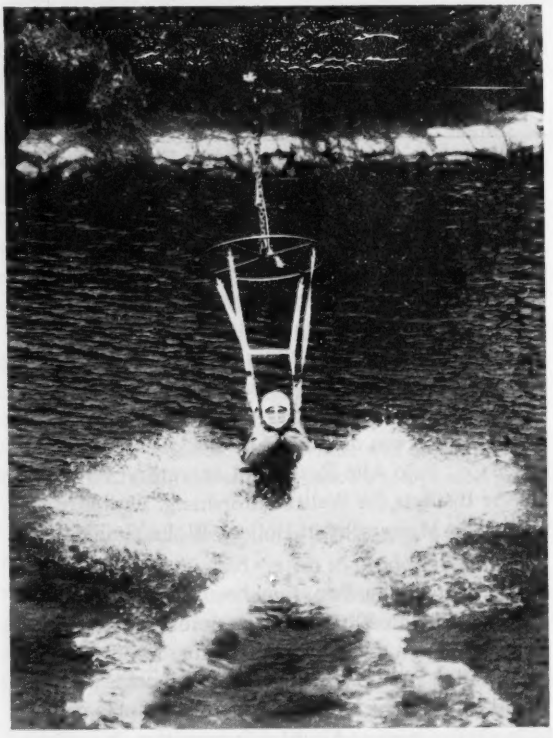
Other contending theories propose comets colliding with dense neutron stars or gigantic outbursts from brilliant supernovae as causes of gamma ray bursts.

Astronaut Candidates Learn Water Survival Techniques

Sixteen astronaut candidates from the Johnson Space Center spent July 31 to Aug. 4 in training at the Homestead Air Force Water Survival School in Florida. Most of the 35 astronaut candidates had experienced the water survival training before entering the NASA program. Included among the 16 are the six female astronaut candidates now in training.

Each day's activities during the course included classroom lectures on water survival techniques plus actual training in the water environment. Briefings on procedures preceded each activity.

No Bellhops Needed—Astronaut candidate Judith Resnik carries training gear to a large freshwater tank at Turkey Point, Fla. to clean saltwater from equipment, a program requirement.



Splashdown!—An astronaut candidate hits the water after sliding down the wire from a 13-meter tower. Afterward, the student must release from the parachute harness, swim under a parachute canopy and climb into a life raft.

The training also covered jumping from a tower while wearing a tethered parachute harness, and sliding down a wire to a landing in the water. The candidates also were towed through the water in a parachute harness, a simulation of being dragged across the surface by parachute and having to accomplish release.

Determined Effort—Candidate Sally K. Ride swims toward the dock in a Florida canal at the water survival training site after the "drop and drag" phase of training.

Sweet Success—Candidate Margaret Rhea Seddon moves away from a lift device after a successful ride out of water. The device is suspended overwater and an electric winch lifts a student, simulating a helicopter pickup.

Other exercises required astronaut candidates to be towed aloft under a parasail canopy, land in the water and be picked up by boat. On the final plunge into the water suspended from the parasail, astronaut candidates came down with full survival gear. A helicopter picked them up from a life raft.

The Air Force Water Survival School is operated by the 3613th Combat Crew training squadron with headquarters at Fairchild Air Force Base, Wash.

Contractors News

The General Electric Co., Valley Forge Space Center, Valley Forge, Pa., has been selected by NASA for negotiation of a cost-plus-award-fee contract to provide the Landsat–D mission system. The system will include a Landsat–D flight segment (and backup) and a ground segment that will include a data management system, an operations control center, a Landsat assessment system and a transportable ground station. The project will be managed by the Goddard center. General Electric's proposed cost is about $70.5 million. Duration of the contract covers the Landsat–D launch in late 1981 and initial orbital operations. The flight segment, to be placed in orbit by a Delta launch vehicle, will include a multimission modular spacecraft and an instrument module. The thematic mapper is a second generation multispectral scanner with a group resolution of about 30 meters. It is a seven-band scanning radiometer that will provide improvements in the inventorying and management of Earth resources.

A $32 million contract has been awarded to the **Martin Marietta Corp.,** Denver, for development of the teleoperator retrieval system, a reusable, TV-equipped propulsive device to be used by Space Shuttle crewmen to deliver, stabilize and recover satellites in orbit. The contract, managed by the Marshall center, calls for the delivery of flight hardware by September 1979. The TRS is a low-thrust, box-like spacecraft to be operated by remote control from the Shuttle. It can be carried to and from Earth orbit in the orbiter cargo bay or it may be left in space after completion of its mission to wait for the next Shuttle to retrieve it for return to the Earth where it can be refurbished and readied for subsequent missions. The first mission planned for this new spacecraft will be to dock with the Skylab space station and boost it to a higher orbit or to control its reentry into the Earth's atmosphere. For such a mission the TRS will include additional

propulsion kits for added energy. The Space Shuttle will take the TRS to low Earth orbit where it will be ejected from the cargo bay. An astronaut will operate it by remote control from the Shuttle orbiter cockpit.

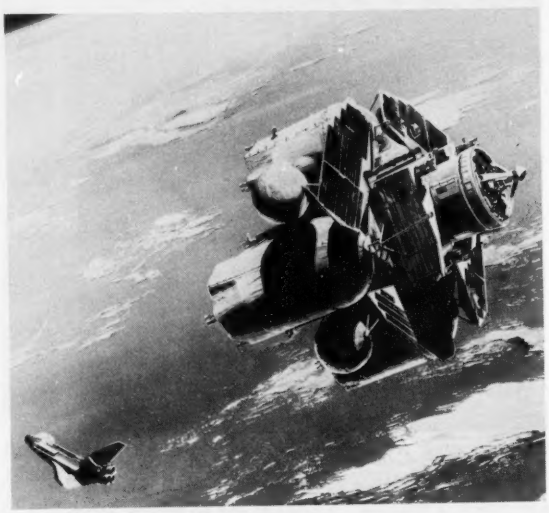
TRW Defense and Space Systems Group of Redondo Beach, Calif., has been selected by NASA for negotiations leading to the award of a contract for the materials processing in the Space-Spacelab program at an estimated cost of about $9.7 million. TRW will serve as prime contractor for the various aspects of the program which will utilize Spacelab and related facilities. The contract will be for the initial phase of the MPS-Spacelab payloads project and is expected to begin this month and continue through 1981. The contract covers development and support of the operation of specialized and general purpose payload systems designed to accommodate a variety of different materials processing experiments during a series of recurring Earth orbit missions of the Space Shuttle. The first series of experiments to be performed were selected from proposals sent to NASA by scientists from throughout the United States and numerous foreign countries. The MPS program is under the direction of NASA's Office of Space and Terrestrial Applications in Washington, D.C. The Marshall center has project management responsibility for the operational aspects.

The IBM Federal Systems Division of Gaithersburg, Md., has won a supplemental agreement to a cost-plus-award-fee contract from the Johnson center covering the development and testing of software for the Space Shuttle orbiter avionics. The supplement also covers orbiter test and laboratory at the Johnson and Kennedy centers and at Rockwell International's orbiter assembly plant at Palmdale, Calif. Valued at about $39 million, the supplement brings the value of the total IBM contract to $93 million.

The McDonnell Douglas Corp., McDonnell Douglas Astronautics Company (West) of Huntington Beach, Calif., has been awarded a non-competitive follow-on fixed price-incentive contract in the amount of about $66 million by NASA. Work will be performed at McDonnell Douglas, at the Vandenberg Air Force Base, and at the Eastern Test Range, Fla. The contract involves the configuration, checkout and launch of the Delta space vehicle. Deltas over the last 17 years have launched 143 weather, communication and scientific satellites plus deep space probes and have a record of 132 successful missions. Technical direction of the Delta program is performed by the Goddard center under the direction of NASA's Office of Space Transportation Systems.

The Massachusetts Institute of Technology received a $65,000 contract from the Marshall center for a seven-month study to investigate whether the potential economic and environmental advantages of large space system material delivery and construction from extraterrestrial sources indicated by earlier studies could be realistically achieved. Prof. Rene H. Miller of MIT is the principal investigator. The study will assume that materials have been mined and preprocessed on the lunar surface and will cover final processing in space to commercial grade materials as required for manufacturing. It will also explore manufacturing processes required to produce large space system components and elements.

The Ford Aerospace and Communications Corp. at Houston has been selected by the Goddard center for negotiation of a contract to provide nine telemetry and command (TAC) systems at Goddard for communication with the tracking and data relay satellite system. The contractor's estimated cost of the cost-plus-fixed-fee contract is more than $1 million, with work to be completed within two-and-a-half years after the contract has been signed. Each TAC will consist of hardware and software in the Goddard communications link with the TDRSS ground station. Expected to become operational in the early 1980's, the system will consist of orbiting satellites and a ground station to perform the satellite tracking and data acquistion operations now handled by a network of ground stations throughout the world.



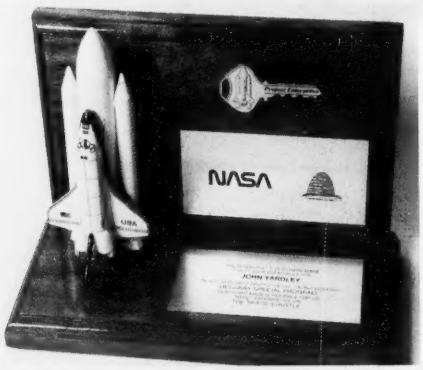
The Teleoperator Retrieval System

Launches for 1978—Completed and Projected

Name	Launch Date	Vehicle	Range	Mission Remarks
Intelsat IVA-(F)	Jan. 7	Atlas-Centaur	ETR	Improved communications satellite for Comsat. Reimbursable.
IUE-A	Jan. 26	Delta	ETR	International Ultraviolet Explorer—cooperative with ESA. Designed to obtain high resolution data on stars and planets in the ultraviolet region of the spectrum.
FLTSATCOM-A	Feb. 9	Atlas-Centaur	ETR	Navy fleet satellite communications. Reimbursable.
Landsat-C	March 5	Delta	WTR	Third Earth resources technology satellite.
Intelsat IVA-F6	March 31	Atlas-Centaur	ETR	Improved communications satellite for Comsat. Reimbursable.
Japan/BSE-A	April 7	Delta	ETR	Broadcasting satellite experimental. Japanese communications satellite for conducting TV broadcast experiments, Reimbursable.
AEM-1 (HCMM)	April 26	Scout	WTR	Heat capacity mapping mission to produce thermal maps for thermal intertial measurements, investigate feasibility of geothermal source location by remote sensing, and provide coverage of snow field for water runoff prediction.
OTS-B	May 11	Delta	ETR	ESA orbital test satellite.
Pioneer Venus-A	May 20	Atlas-Centaur	ETR	Planetary mission to Venus. Orbiter will measure upper atmosphere and ionosphere, study interaction between solar wind and ionosphere and magnetic field, study atmospheric and surface characteristics, determine gravitational field harmonics.
NOAA/ GOES	June 16	Delta	ETR	Part of global network of geostationary environmental satellites to provide Earth imaging, monitor the space environment, and relay meterological data to users. Remibursable.
Seasat-A	June 26	Atlas-F	WTR	Sea satellite for global monitoring of ocean geoid, wave topography, surface wind speed and direction, ocean surface temperature, and ice field extent and dynamics.
Comstar-C	June 29	Atlas-Centaur	ETR	Third in a series of domestic communications satellites for Comsat. Reimbursable.
ESA/GEOS-B	July 14	Delta	ETR	ESA spacecraft to conduct scientific, investigation of waves and particles in magnetosphere. Reimbursable.
Pioneer Venus-B	Aug. 7	Atlas-Centaur	ETR	Multiprobe—will determine nature and composition of clouds, composition structure and general circulation pattern of the atmosphere of Venus from the surface to high altitudes, study interaction between planetary environment and interplaneary medium.

ISEE-C	Aug. 12	Delta	ETR	International Sun Earth Explorer. An extension of interplanetary studies with the spacecraft toward the Sun sufficiently outside the Earth's influence for comparison with results of ISEE-A and B missions and of space probes to outer planets.
Japan Backup	Sept.	Delta	ETR	Backup spacecraft for Japan.
Navy-20	Sept.	Scout	WTR	Navy navigation satellite. Reimbursable. (Call-up.)
NOAA-A	Sept.	Atlas-F	WTR	Advanced operational prototype spacecraft and sensors for a third generation series of operational meteoroligical satellites. Reimbursable.
Nimbus-G	Sept. 18	Delta	WTR	Develop and flight test advanced sensors and technology basic to conducting experiments in the pollution monitoring, oceanographic, and meteorological disciplines.
TIROS-N	Sept. 15	Atlas-Centaur	WTR	Polar orbiting operational spacecraft to provide and improve meteorological data.
NATO III-C	Oct.	Delta	ETR	Communications satellite, second in series.
HEAO-B	Oct.	Atlas-Centaur	ETR	Second high energy astronomical observatory to study highly energetic radiation from space.
Telsat-D	Nov.	Delta	ETR	Canadian domestic communications satellite. Reimbursable.
FLTSATCOM-B	Dec.	Atlas-Centaur	ETR	Navy fleet satellite communications. Reimbursable.

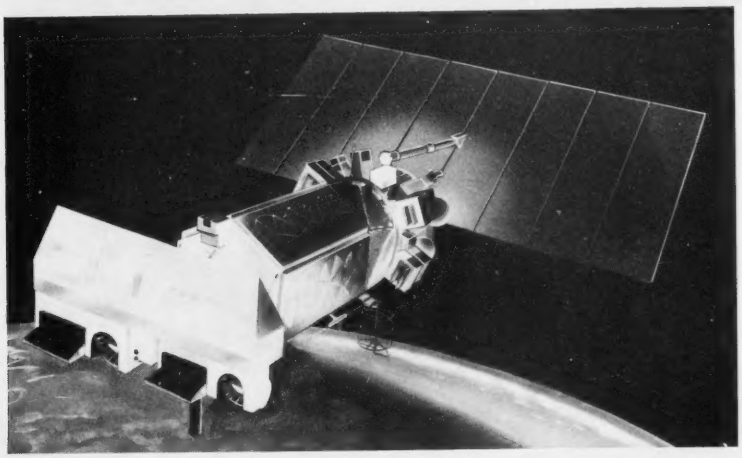
Award to NASA Official from Students—John F. Yardley (r.) accepts a plaque (see second photo) from R. Gilbert Moore, representing Utah students, in appreciation of Yardley's work in establishing NASA's "Getaway Special" program aboard the Space Shuttle. The plaque was made by students at Utah State University. Students from the university and from four other academic establishments in the state have reserved space on the Shuttle for self-contained payloads to go aboard the Shuttle—scheduled for orbital flight in 1980—under the getaway program. Moore, general manager of the Thiokol Corporation's Astro-Met plant in Ogden, Utah, is the voluntary organizer for educational uses of the getaway special concept. The other four Utah schools that are active participants in the program are: Weber State College (Ogden); Weber County School District (a high school in Ogden); University of Utah at Salt Lake City; and the Box Elder School District at Brigham.



Patents for Inventions from NASA Research

The Office of General Counsel, NASA Headquarters, announces that the following U.S. patents have been issued by the U.S. Patent Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel of the indicated installation.

Investor(s) and Employer	Title	Patent No.	Installation
E. Vernon Ballou, Peter C. Wood, Leroy A. Spitze, Theodore J. Wydeven, Jr. — ARC	Process for the preparation of calcium	4,101,633	ARC
Johan H.C. Rieber, ARC	Contour detector & data acquisition system for the left ventricular outline	4,101,961	ARC
Izhak Etsion, National Research Ctr.	Cantilever mounted resilient pad gas bearing	4,099,799	LeRC
Atul Jain, JPL	Surface roughness measuring system	4,101,891	NRLO
Barbara S. Askins, MSFC	Method of obtaining intensified image from developed photographic films and plates	4,101,780	MSFC
Robert C. Costen, LaRC	Smokestack mounted airfoil	4,099,452	LaRC
R. J. Wojtasinski, J. C. Fuchs, C. Grove — KSC & Federal Electric Corp.	Lightning current waveform measuring system	4,100,487	KSC
Herbert S. Kobayashi, Joe Fowler, William Kurple — MSFC	Bit error rate measurement above & below rate tracking threshold	4,100,531	MSFC
George M. Weyler, Jr.	An improved rotatable mass for a flywheel	4,098,142	MSFC
Marion L. Roberts, Max H. Sharpe, Albert C. Krupnick — MSFC	Aluminum or copper substrate panel for selective absorption of solar energy and the method of producing said panel	4,104,134	MSFC
John C. Evans, Jr., LeRC	Method for fabricating solar cells having integral collector grids	4,104,084	LeRC
John C. Evans, Jr. et al/LeRC	Application of semiconductor diffusants to solar cells by screen printing	4,104,091	LeRC
Vincent J. Menichelli, Calif. Inst. of Tech.	Electroexplosive device	4,103,619	NRLO
Morley V. Friedel, Martin Marietta	Positive isolation disconnect	4,103,712	JSC
Richard A. McKay, Caltech/JPL	"Combuster"	4,104,018	JPL

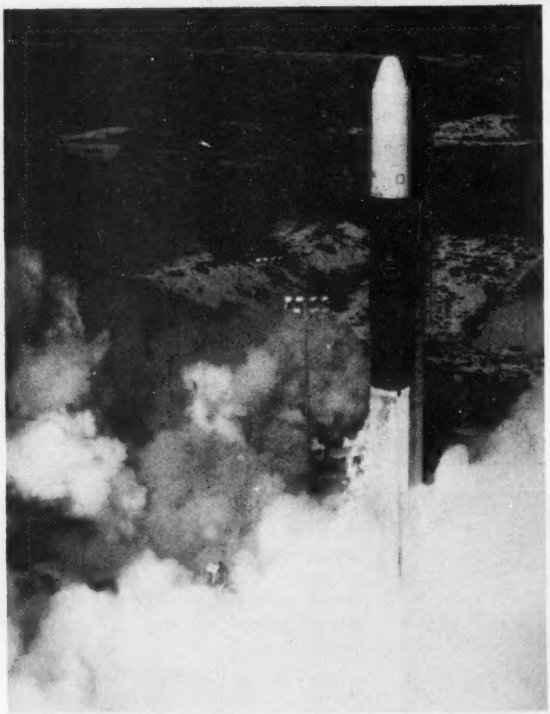


Weather Watcher—This picture depicts the RCA-built Tiros-N, a new third generation operational meteorological spacecraft. Scheduled for launch by NASA in the fall of 1978, the advanced polar-orbiting satellite will carry a broad array of sophisticated sensors to provide greatly improved data for use in world-wide weather forecasting and environmental observation. The Tiros-N spacecraft is being developed by RCA Astro-Electronics, Princeton, N.J., for the National Oceanic and Atmospheric Administration.

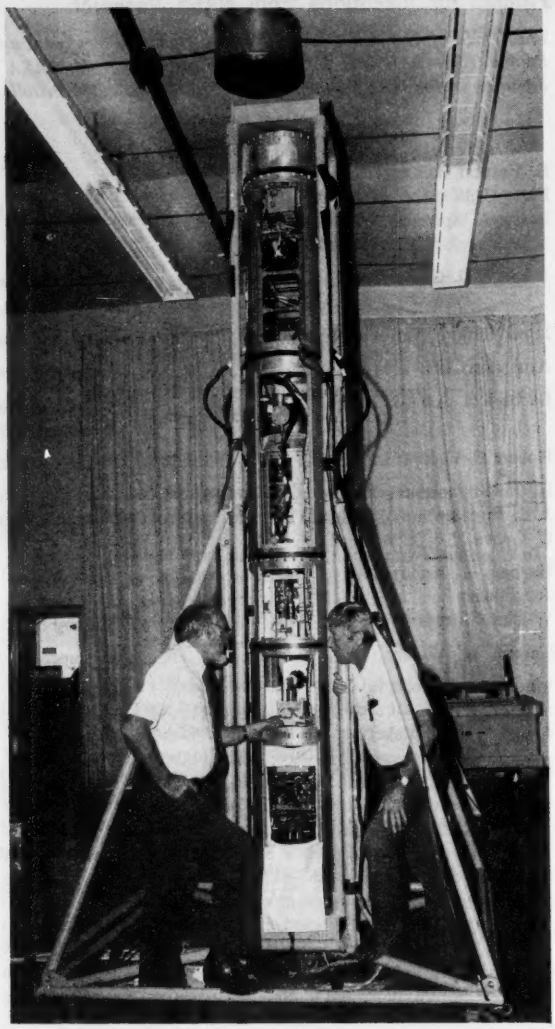
New Space Books

Stackpole Books of Harrisburg, Pa., will issue two books on October 26 that cover a wide variety of space subjects. These comprehensive volumes are entitled: "Planetary Encounters" by Robert M. Powers with original drawings by Helen Zane Jensen (196 pages, 123 photographs and eight pages of full-color photos; cost $13.95); and "Space Trek, The Endless Migration" by Jerome Clayton Glenn and George S. Robinson (224 pages, 99 photos; cost $9.95). Each of these books spans many years and numerous aspects of man's journeys into the far reaches of the universe, both completed and projected.

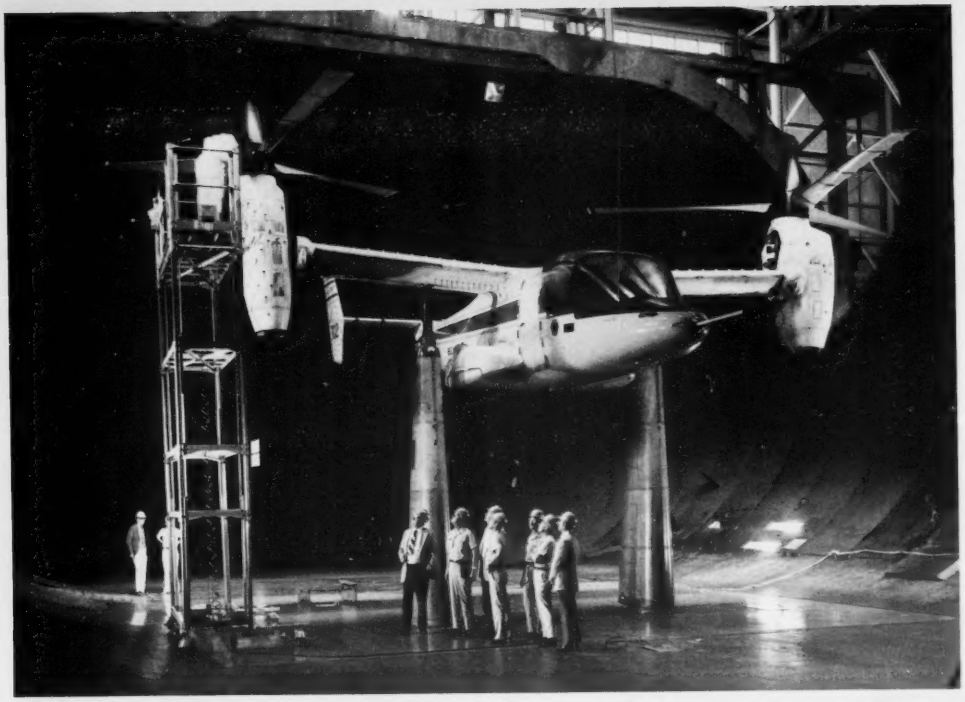
The publication date of the two volumes coincides with the 20th anniversary of NASA.



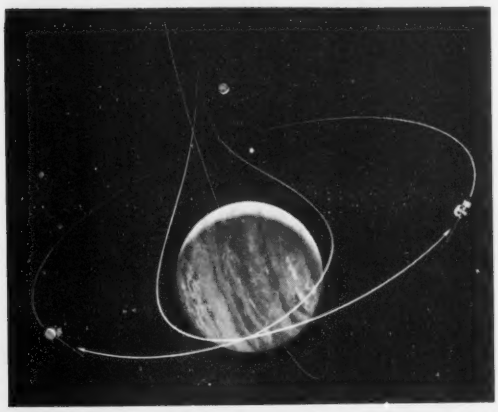
Unusual View of Launch—Taken from a nearby tower at launch of Landsat 3, the spacecraft is shown moments after ignition of the Delta launch vehicle at the Western Test Range in Lompoc, Calif.



SPAR V Payload—This tall cylinder is packed with equipment that soon will help add to man's knowledge of how to use the environment of space to produce new and improved materials. The cylinder is a mini-laboratory, containing five experiments designed to melt and solidify different materials and record the process for later study. After completing checkout procedures at the Marshall center, the lab will be fitted to a Black Brandt sounding rocket for a short flight into the fringes of space. During five minutes of near weightlessness, it will quickly conduct the experiments and electronically record and photograph the entire process. This is to be the fifth flight in NASA's Space Processing Applications Rocket program to gain additional knowledge of the behavior of materials in space in preparation for full-scale space processing when the Space Shuttle and Spacelab begin routine flights. Pictured are Lloyd Engman (left) and Roy Darnell, engineers at the Marshall center.



XV–15 Tilt Rotor in Wind Tunnel—Army and NASA officials recently inspected the XV–15 aircraft undergoing tests in the wind tunnel at Ames. Picture shows (l. to r.): Dr. Richard M. Carlson, Director, U.S. Army Research and Technology Laboratories; Col. William E. Dasch; Mark W. Kelly, chief of the wind tunnel at Ames; Col. Kenneth Calcatera; Lt. Col. James H. Brown, Jr.; Col. John B. Fitch; and Dr. Irving C. Statler. The first Army NASA Bell Helicopter Textron tilt rotor research aircraft is shown after completion of six weeks of successful wind unnel tests including tests with the rotors. It was operated as a helicopter to 123 knots and as an airplane to speeds of 180 knots. Conversions were readily accomplished at speeds from 100 to 170 knots. Helicopter autorotation was checked at 80 knots and startups and shut-downs were performed in 60-knot winds. The results of the tests will further expand the flight envelope of Bell's second XV–15, scheduled to make a full conversion to the airplane mode in September at the company's test facility in Arlington, Texas. The company is working under a contract with NASA and the U.S. Army Research & Technology Laboratories (AVRADCOM) to design, manufacture and test two VTOL aircraft. The tilt rotor is expected to combine the best features of the helicopter and conventional airplanes for fast point-to-point transportation. The first aircraft made its initial hover flight on May 3, 1977. The current testing was successfully completed June 22. Headquarters of the Army Research and Technology Laboratories is located at NASA Ames Research Center, Moffett Field, Calif.



Blueprint for Solar Polar Mission—How an artist views the trajectories to be followed by the two Solar Polar spacecraft, now under consideration as a future space mission. After launch from Earth aboard the Space Shuttle, the two unmanned spacecraft would fly out to Jupiter and use the giant planet's gravity to boost them out of the ecliptic plane and back toward the Sun. The mission would be a joint effort of NASA and the European Space Agency.

Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

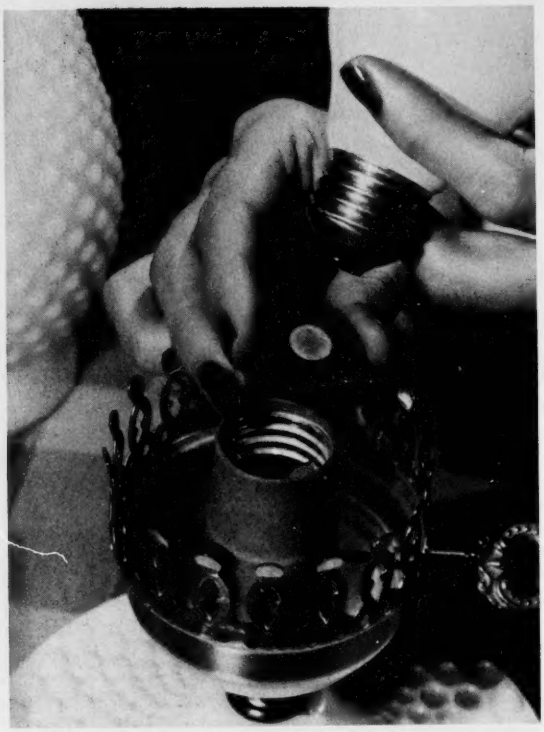
A Super Saver Light Bulb

Technically known as a "temperature compensating thermistor," the inexpensive "Bulb-Miser" increases the life of an electric bulb by 300 percent while reducing amperage—and at under $1.00 per bulb. (Cost is much less when bulk purchases are made.)

The Bulb-Miser looks like a washer about the size of a quarter. It is slipped between bulb and socket and can be used with any incandescent bulb that screws into a standard socket.

In addition to delaying burnout, the device also offers a reduction of electrical energy. But the economy of the Bulb-Miser goes beyond energy use or bulb cost: to big users of bulbs, it makes possible substantially lower maintenance labor costs. One field test involving an apartment complex showed that it took two men 30 man hours each month to replace light bulbs, but after Bulb-Misers were installed, the same job took only nine man hours a month. The same sort of savings applies to banks, office buildings, hospitals and other large-scale users of light bulbs. Because the protective covering of silicone rubber will withstand the ravages of time, weather and temperature, Bulb-Miser also is useful in outdoor areas. The broadest use is by industrial facilities

The device was developed during NASA's Apollo program to protect the Saturn launch vehicle from electrical current surge. It is now being produced for the commercial market by Bulb-Miser, Inc., 269 Giralda Ave., Suite 300, Coral Gables, Fla. 33134.



Energy and Money Saver—The Bulb-Miser is inserted in a light socket, under a standard electric light bulb, to significantly increase the life of the bulb.

For the benefit of all . . .

NASA
National Aeronautics and Space Administration

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